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GEOPHYSICAL YEAR INFORMATION

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PLEASE NOTE

This report presents unevaluated information on Soviet Bloc International Geophysical Year activities selected from foreign-language publications as indicated in parentheses. It is published as an aid to United States Government research.

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I. ROCKETS AND ARTIFICIAL EARTH SATELLITES

Use of Satellites for Radio Astronomical Studies

The use of artificial earth satellites for optical astronomy is desirable in connection with the possibility of broadening the spectrum of the waves being received. Specifically, near and far ultraviolet, X-ray, and far infrared radiation which does not reach the Earth because of its absorption in the atmosphere can be received by satellites. In the case of radio astronomy, the position is analogous inasmuch as the range of the waves being used on the one hand is also limited by their absorption in the troposphere, and on the other, the range in the long waves is limited by their refraction and absorption in the ionosphere.

The use of satellites for the investigation of long-wave radio emissions from space eliminates the problem caused by ionospheric interference to a considerable degree, and suitable receiving apparatus is relatively simple. In this relation the authors have in mind only the so-called "general" galactic radio emission and are not concerned with long-wave radio emissions from separate discrete sources which can be observed only with very large antennas or interference devices.

The use of a five-tube superheterodyne receiver in a satellite operating on a 100-meter wavelength would require a wire antenna several tens of meters long. A more suitable design, in this case, is the application of a loop antenna with ferrite cores. The ferrite antenna has a relatively large radiation resistance with very small dimensions (length ~ 10 centimeters, weight ~ 300 grams). The axis of the arms should lie parallel to the satellite's metallic surface.

Because of the rotating motion of the satellite and the resulting changes in the orientation of the loop antenna, the intensity of the cosmic radio emission being received can be somewhat lessened. It is necessary to know, therefore, the orientation of the antenna arm for each moment. However, because the cosmic radio emission in the range being considered is approximately isotropic, it is possible to make use of only the maximum readings of the output instrument. A very important advantage of observations of cosmic radio emission with $\lambda > 100$ meters is the great decrease in atmospheric and other types of interference, because during the movement of the satellite above the maximum F2 layer the receiver in it will be screened from the surface of the Earth.

Data on the frequency spectrum of the intensity of cosmic radio emission on a wavelength of $\lambda = 100$ meters will permit certain conclusions to be made on the electron concentration at corresponding levels of the ionosphere lying above the maximum F2 layer, not possible using radio-sondes. ("Radio Astronomical Investigations With the Aid of Artificial Earth Satellites," by G. G. Getmantsev, V. L. Ginzburg, and I. S. Shklovskiy: Moscow, Uspekhi Fizicheskikh Nauk, Vol 66, No 2, 1958, pp 158-161)

Layka Experiments Show Definite Possibility of Human Space Flight

The second Soviet artificial earth satellite that carried the dog Layka was launched and placed into orbit on 3 November 1957. This permitted the Soviet scientists to learn, for the first time, about vital functions of an animal organism beyond the limits of the atmosphere and brought closer the solution of the problem of launching space ships with human passengers.

Considerable work has been done during the past year in deciphering the data that were received from that earth satellite. This information threw much light on the physiological condition of the dog Layka while it was flying through space. Recordings were made of blood circulation, respiration, and general motor activity of the organism of the dog. An electrocardiogram was used to record the biocurrents which arise during heart contractions. Another method used to determine blood pressure was to measure the arterial pressure. Respiration was determined by frequency of respiratory movements. The general condition of Layka was judged by the animal's gross movements.

Silver electrodes were implanted into the soft tissues of the chest of the animal to get electrocardiogram recordings. Respiration movements were discerned by means of rheostatic pickoffs which were positioned around the chest of the animal. Arterial blood pressure was measured by means of the carotid artery which had been brought out into a cutaneous strip on the neck.

Layka's movements were converted into impulses of electric current with the aid of a potentiometric pickoff.

The biological experiment that was conducted with the aid of the second artificial earth satellite was divided into three main periods: the period before launching the satellite, the period between launching of the rocket and the time the artificial earth satellite entered its orbit, and the period during which the satellite remained in its orbit.

The third period was the most interesting one. The chief feature of this period was the dynamic weightlessness. Before launching the weightlessness of the second artificial earth satellite was studied with the aid of rockets, but lasted no more than 5-6 minutes.

The experiment with the second artificial earth satellite showed that a highly organized animal organism is capable of enduring conditions created by cosmic flights, particularly the effects of great acceleration and prolonged period of dynamic weightlessness.

These conclusions provide a sufficient basis to state with confidence that the day is not far away when mankind will see humans flying in outer space. ("A Notable Scientific Experiment," an interview with V. V. Parin, Active Member of the Academy of Medical Sciences USSR; Sovetskaya Aviat-siya, 4 Nov 58, p 3)

End of Sputnik III Carrier Rocket

The end of Sputnik III's carrier rocket came on 3 December. In its lifetime the carrier rocket made 2,907 revolutions of the Earth and traveled a total distance of 130 million kilometers. ("Movement of Sputnik III"; Moscow, Izvestiya, 9 Dec 58, p 4)

II.. METEOROLOGY

Soviet Study on Connection of Ozone Content With Meteorological Conditions

A great deal of attention, especially in connection with the IGY, has recently been given to the study of atmospheric ozone. This can be explained by the particular importance this meteorological factor has for the solution of a number of problems of physics of the stratosphere and physics of the atmosphere as a whole. The most widely used methods of measuring ozone at present, according to direct sunlight and scattered light from the zenith sky, are limited by weather conditions. On days of variable cloudiness, measurements of the vertical distribution of ozone cannot be made, and in measurements of the total ozone content it is necessary to introduce corrections for the aerosol components, which considerably complicates processing of the results of the measurements.

The establishment of an interconnection between ozone content and synoptic processes (the shifting of air masses, the passage of cyclones and anticyclones) presupposes the conduct of continuous measurements of ozone for several days in order to more fully explain the different stages of the meteorological process being studied in relation to variations in the amount of ozone in the atmosphere.

The study of changes in the total content of atmospheric ozone with simultaneous observations on other meteorological phenomena was undertaken by the Central Aerological Observatory in the European territory of the USSR. The region selected was along the lower Volga at a point 48° 13' N latitude and 45° 44' W longitude. The measurements were made during the period from 27 April to 8 June 1957. This period of local springtime coincides with the time of maximum intensity of the seasonal variation of total ozone content.

The basic instrument used was a photoelectric spectrophotometer (a version of Dobson's instrument) built in Moscow State University named M. V. Lomonosov. The instrument was located in an open area about 1.5 meters above the ground. The angle covering the horizon to the east and west did not exceed $1^{\circ} 30'$. Zenith distances of the Sun were determined with the aid of an optical theodolite, equipped with a filter, and had an accuracy of up to 0.1 percent. A thermoelectric actinometer was used for evaluating the transparency of the atmosphere. Values of the intensity of the integral of direct solar radiation were obtained through readings of a microammeter coupled to the actinometer. The actinometer was fastened to the theodolite tube in a position ensuring parallelism of the optical axes of both instruments. Thus, in determining the zenith distances with the theodolite the actinometer was brought to bear precisely on the Sun, ensuring high accuracy in determining the intensity of direct solar radiation.

In addition to the above measurements, visual observation of the amount and type of cloudiness and optical phenomena in the atmosphere were conducted, and the temperature, pressure, wind direction, and speed at ground level were taken by using standard meteorological instruments. Air currents in the troposphere and lower stratosphere, the boundary separation of the air masses, and the height of the tropopause over the point of observation were established.

The total ozone content was calculated according to the formula

$$X = \frac{\log \frac{I_0}{I_1} - \log \frac{I}{I'} - (\beta - \beta') \sec z}{(a - a') \sec z}$$

where x is the total ozone content in centimeters at normal temperature

and pressure; $\frac{I_0}{I_1}$ is the ratio of the values of the intensity of two different wavelengths of the solar spectrum beyond the limits of the atmosphere; $\frac{I}{I'}$

is the ratio of the values of the intensity of two different wavelengths of the solar spectrum on the surface of the Earth; β and β' are the coefficients of light scatter by the air for two different wavelengths; a and a' are the coefficients of the absorption of light by the ozone for two different wavelengths; m and μ are, correspondingly, the masses of air and ozone; and z is the zenith distance of the Sun.

The value, $\log \frac{I_0}{I_1}$, was determined by means of observations of direct sunlight on a day when atmospheric conditions could be considered constant. Graphics of the relationship of the intensity of direct solar radiation to the Sun's zenith distance were constructed according to actinometric measurements for each day of observation. Days with maximum atmospheric

transparency were determined on the basis that the transparency of the atmosphere was proportional to the intensity of the direct solar radiation for one and the same value of the zenith angle on different days.

A graph showing the values of the total ozone content, the atmospheric pressure at ground level, and the heights of the tropopause for the period of the observations is given. A comparison of the values of the total ozone content with the height of the tropopause indicated that, as a rule, the higher the tropopause, the less ozone in the atmosphere, and vice versa. There is undoubtedly a connection between the ozone content and the atmospheric pressure at ground level: the large values of ozone have a tendency to coincide with low pressure at the Earth's surface, but this relationship is less clearly expressed than in the preceding case. The temperature at a level of 2 meters is correlated with the ozone content much more poorly. An interesting occurrence is that the appearance of extremal values of the total ozone content is preceded by the appearance of extremal values of the height of the tropopause, whereby the shift of the phase consists of a value approximately equal to one day.

The experimental data obtained confirm the presence of a connection between processes originating in the troposphere and the lower stratosphere, and indicate that one of the basic reasons for the changes in the condition of atmospheric layers up to altitudes of 20-25 kilometers are changes in the state of the atmosphere in the underlying layers. It also follows, from the same data, that the establishment of a balance between the processes of the formation and decay of ozone occurs not instantly, but over a long period, being calculated in tens of hours.

It was found that, although fluctuations in the height of the tropopause corresponded very well with changes in the total ozone content, it was impossible to establish a quantitative relationship between them without considering other factors causing fluctuations in the height of the tropopause and the total ozone content in the atmosphere.

At present a representation of the connection of the total ozone content with the altitude of the tropopause and with the shift of air masses has not been established.

The following illustrates the connection of synoptic processes with the height of the tropopause and the total ozone content.

In the latter part of April in the lower Volga region, damp air borne by a southeastern current from Central Asia along the western periphery of a cyclone centering over the Aralskoye More [Aral Sea] was observed. This period was characterized by the lifting of the tropopause and a decrease in the total ozone content by approximately 0.01 centimeter per day. In the beginning of May the lower Volga falls under the influence of a cyclone

whose center is in the region of the Black Sea. In the following days with a deepening of the cyclone, the transfer of warm air at high altitudes and at the Earth's surface by the southeast current is intensified. Beginning with 6 May there begins an influx of cold air in the rear of the cyclone located above Scandinavia. The passage of fronts accompanied by overcast skies made it impossible to obtain data on the changes of the quantity of ozone in that period. Measurements taken on 11 May showed a relatively high ozone content with the invasion of cold air. With the deepening, during the next 3 days, of the cyclone over the Black Sea, after the raising of the warm front to the north, there occurs an influx of warm continental air borne along by the southeast current which is accompanied by a drop in the total ozone content.

The characteristic decrease in the height of the tropopause and increase in the ozone content were noted with the passage of the cold front on 17-18 May. This front, weakly expressed near the surface of the Earth, was well detected according to high-altitude charts and, extending into the stratosphere, caused a notable increase in the ozone content. The spread, during the succeeding days by the southwest current, of a trough with frontal boundaries resulted in a lowering of the level of the tropopause and a decrease in the total ozone content.

The inflow on 26-27 May of cold air with the north and northeast current caused a sharp lowering of the level of the tropopause and an increase in the ozone content. The passage of the front near the surface of the Earth preceded the appearance of the minimum height of the tropopause by approximately one day, and the maximum content of ozone, by 2 days.

A similar lagging of the extremal values of ozone content in relationship to the extremal values of the height of the tropopause were well detected on 24-25, 27-28, and 29-30 May and 1-2 June.

A similar variation in the total ozone content was observed from 3 to 7 June. A diffused cold front passed through the region of the observations during the day on 3 June and was accompanied by a decrease in the ozone content by approximately 0.1 centimeter. The content of ozone in the course of the following 3 days occurred at an anomalously low level, practically unchanged with time, and changed on 8 June with a rise connected with the passage of a new cold front.

This example is of especial interest in connection with a consideration of Normand's hypothesis ["Atmospheric Ozone and Upper Air Conditions," Quart. J. Roy. Met. Soc., 79, No 339, 39, 1953] which considered the advection theory of ozone fluctuations insufficient for explaining all the possible cases of changes in the total ozone content in the atmosphere.

The appraisal of the role of horizontal advection and vertical movements in the process of changes in the total ozone content can be made only by an analysis of daily data on the ozone content and the velocities of wind from a network of ozonometric stations. ("The Connection of Total Ozone Content With Meteorological Conditions," by A. S. Britayev, V. A. Iozenas, and A. P. Kuznetsov; Leningrad Meteorologiya i Gidrologiya, No 10, Oct 58, pp 24-29)

Sun Pillar and Mock Suns Observed at Maykop

A rare atmospheric phenomenon was observed in Maykop on 17 February 1958. At 0700 hours (Moscow time) when the Sun was still below the horizon, a Sun pillar, whitish in color, was noticed in a background of cirrus clouds. The pillar was as wide as the visible disk of the Sun and reached to a considerable height.

The sky was covered with a nonuniform veil of upper strata clouds, the basic mass of which consisted of cirro-stratus, whose threads ran from south southwest to north northeast, and cirro-cumulus located under the cirro-stratus. The threads of the cirro-filum were perfectly parallel and well expressed.

At 0730 the height of the pillar over the Sun, which had risen 1.5 degrees over the horizon, was measured. It was 19.5 degrees. At this time, on the Sun's right, a small halo of 22 degrees without visible color was seen. At 0734 a similar arc appeared on the Sun's left side. At this time the pillar's height over the Sun was 16 degrees.

At 0737, at a height of 6 degrees from the Sun, a blurred and extended brightness appeared on the pillar with a resultant loss in the sharpness of its edges. At 0740 the height of the pillar decreased to 13 degrees and the Sun had risen to 3 degrees above the horizon. To the left and right, on the 22 degree halos there appeared colored mock Suns. At 0747 the mock Sun on the left became more brightly colored and the pillar's height had decreased to a height of 10 degrees.

At approximately the same time a bank of cirro-cumulus clouds formed in the direction of the Sun at a height of 16 degrees above the horizon. At 0808 the bank of cirro-cumulus moved in front of the Sun and the pillar and the halo on the right side disappeared. By 0820, the halo on the left had also disappeared.

The temperature of the air was 10 degrees centigrade. A strong foehn wind from the southwest was present. A warm front, with westerly flows at heights of 3.0-5.5 kilometers and speeds of 18-25 meters per second, was located about 1,000 kilometers to the west of Maykop. The front ran from north to south. A strong advection of warm air was observed in the high altitudes over the Northern Caucasus. ("Rare Optical Phenomenon in the Atmosphere," by F. V. Oblakov; Leningrad, Meteorologiya i Gidrologiya, No 10, Oct 58, p 42)

New Hydrometeorological Observatory in Ukraine

A new hydrometeorological observatory has been built in Kremenchugges-stroya village for studying the peculiarities of the microclimate in connection with the formation of the Kremenchugskoye More [inland lake or reservoir] in the center of the Ukraine. ("About Everything From Everywhere"; Moscow, Izvestiya, 4 Dec 58, p 4)

III. ARCTIC AND ANTARCTIC

Antarctic Continental Expedition

The Soviet continental expedition into the interior of Antarctica has been in progress for the past 2 months. Two sled-tractor trains arrived at the station Komsomol'skaya early in November, after traveling 870 kilometers from the coast of Davis Sea. From Komsomol'skaya the train moved farther south. One column of vehicles left Komsomol'skaya on 30 November and headed for the south geomagnetic pole, in order to supply the station Vostok with the necessary equipment for new research work. The second sled-tractor train, consisting of five caterpillar tractors, four trailer sledges, and one mobile hut, proceeded in the direction of the pole of relative inaccessibility. A large group of scientists will have the task of establishing a temporary scientific station in this remote and frigid region of Antarctica.

Between Pionerskaya and Komsomol'skaya, and farther into the interior of the continent, the traverse party encountered large areas of loose snow. The tractors sank in and got stuck in the snow. The caterpillar tracks left deep ruts. The traverse over the ice sheet was made at a high elevation and under extremely low temperatures.

After overcoming great difficulties, the members of the expedition reached the station Sovetskaya on 29 November, having traveled 1,420 kilometers from Mirnyy. The train is moving at an elevation of 3,700 meters above sea level. The air temperature in the area of Sovetskaya is minus 46 degrees centigrade.

A group of scientists headed by Kh. Zakiyev, chief of the glaciological detachment, are taking part in this expedition. Along the route from Mirnyy into the interior the scientists have conducted seismological, glaciological, meteorological, gravimetric, magnetic, and other observations. A drilling machine is installed in a specially equipped hut on a sledge. The depth of holes drilled in the ice sheet for scientific tests reaches 60 meters. The temperature in these holes is measured at different levels. With a special instrument designed by Docent A. Nikolayev, Candidate of Technical Sciences, and built by workers of the mechanical workshop in Mirnyy, firn samples are obtained without damaging their structure. The drill holes are also used for performing blast operations in seismological research work.

Soviet scientists have obtained new preliminary data on the thickness of the ice sheet in the central regions of Antarctica. These data will be revised after the final processing of the results of scientific observations.

One of the members of the Soviet expedition is the Czech scientist Antonin Mkros, director of the Geophysical Observatory in the High Tatra Mountains. He has been studying the night sky luminescence in Mirnyy, and took part as a navigator in the tractor-sled train expedition into the interior of Antarctica. A. Mkros is gaining experience which he will later pass on to other Czech scientists, who are planning to organize a high-mountain expedition into Central Asia in the next few years. ("On the Continent of Mysteries"; Moscow, Vodnyy Transport, 2 Dec 58)

The Ob' en Route to the Antarctic

The Ob' is in its second week of sailing to the Antarctic. The ship is now in the Atlantic Ocean, approaching the Canary Islands.

Scientific research work began as soon as the ship entered the Atlantic. The aerometeorological detachment under V. Shlyakhov started regular aerological, meteorological, and actinometric observations. Studies of atmospheric electricity are also being made.

The sky is covered with low, heavy clouds; there are frequent rain squalls and visibility is poor. The winds reach a speed of 22 meters per second. In a few days the ship will cross the equator and enter the Southern Hemisphere. ("Approaching the Canary Islands"; Moscow, Vodnyy Transport, 4 Dec 58)

Antarctic Ice Reconnaissance

The polar workers at Mirnyy make ice reconnaissance flights in the area of Davis Sea once a month. In June the ice edge was 540 kilometers from the coast, counting by the Mirnyy meridian. According to data of the latest reconnaissance flight, the ice edge is now [i.e., in mid-October] 850 kilometers from the shore. ("11 Hours Above the Ocean"; Moscow, Sovetskaya Rossiya, 14 Oct 58).

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